



# Waste Reduction Guide

*Measuring Success  
The Alabama Study*



In Alabama a nonprofit 501(3)c corporation, the WRATT Foundation, has been formed. It is a consortium of regulated and regulator, private and public. It includes on its board of directors the Tennessee Valley Authority, the Environmental Protection Agency, the Business Council of Alabama, the Alabama Chemical Association, and the Alabama Department of Environmental Management. It is administered and staffed by retired professionals rehired full time or part time under contract to the Foundation. This study was performed on assessments by WRATT Foundation staff for industries in Alabama.

### **Acknowledgment**

The WRATT Foundation acknowledges the James Graham Brown Foundation, Inc. for a major grant that supported this work, the Tennessee Valley Authority (TVA) for continued generous support, Bill Uhtenwoldt, an independent consultant for assembling the data for this report, and Joseph W. Phillips of TVA's Industrial Waste Reduction staff for his work on the report.

### **Copyright Information**

Permission freely given to copy all or in part with appropriate credit noted.

## **HIGHLIGHTS**

- 35 Companies participated in the survey.
- Total Savings reported was almost 3.5 million dollars.
- Average savings per company was almost \$100,000.
- Benefit to Cost Ratio was 27 to 1.
- During the study period (FY 90-94) TVA's investment was leveraged 7 to 1.

# Contents

			Page
<b>Table of Contents</b>			iii
<b>List of Tables</b>			iv
<b>List of Figures</b>			iv
<b>Introduction</b>			1
<b>Summary</b>			2
<b>Study Results</b>			3
<b>Benefit to Cost Ratios</b>			5
<b>Abstracts:</b>			
<b>WRATT No.</b>	<b>Type of Company</b>	<b>SIC Code</b>	
8/103	Steel Joist Trusses	3441	7
12	Coffee Packaging	2095	7
20	Garbage Truck Bodies	3713	8
21	Sheet Metal Fabrication	3443	8
25	Ceramic Tile	3253	9
26	Ductile Iron Pipe	3321	9
30	Children's Socks	2252	10
32	Rigid Narrow Fabrics	2241	10
41 - 42	Screening and Industrial Fabrics	3496 & 2262	11
45 - 51	Paper Manufacturing	2621	11
57	Dipped Rubber Products	3061	12
67-68	Wood Dining Room Furniture	2511	12
69	Fire Hydrant Manufacturer	3321	13
70	Polyester Fabric	2221	13
75	Steel Mill	3312	14
76	Tapered Roller Bearings	3562	14
79-86	Research Center	49	15
88	Magnetic Recording Tape	3679	15
89	Agricultural Chemicals	2879	16
91	Hydraulic Cylinders	3593	16
95	Portland Cement	3241	17
100	Gauze Material	2211	17
105	Paper Board	2631	18
106	Insulation Material	3313	18
107	Ferrosilicon	2679	19
108	Wire Cages (poultry)	3496	19
109	Electric Plating	3471	20
110	Steel Tubular Products	3317	20
112	Agricultural Chemicals	2879	21
113	Agricultural Chemicals	2879	21
121	Aircraft Parts	3728	22
133	Micro Silica	3339	22
143	Polystyrene	3089	23
148	Clay Refractories	3255	23

## **LIST OF TABLES**

<b>Table 1: Summary of Savings and Reductions</b>	<b>2</b>
<b>Table 2: Reported Reductions in Solid Waste</b>	<b>3</b>
<b>Table 3: Reported Reductions in Hazardous waste</b>	<b>4</b>
<b>Table 4: Reported Utility Savings</b>	<b>4</b>
<b>Table 5: Reported Reductions in Water Usage</b>	<b>4</b>
<b>Table 6: Reported reduction in Volatile Organic Emissions</b>	<b>4</b>
<b>Table 7: Benefit to Cost Ratios for WRATT Assessments</b>	<b>6</b>

## **LIST OF FIGURES**

<b>Figure 1: WRATT Assessments by Fiscal Year</b>	<b>2</b>
<b>Figure 2: Benefit to Cost Ratio</b>	<b>24</b>
<b>Figure 3: Savings per Assessment</b>	<b>24</b>

## **Introduction**

With the passage of the Pollution Prevention act of 1990, Congress established a national policy that pollution should be prevented or reduced at the source whenever feasible. Responsibility for implementing this policy fell primarily to state and federal environmental regulatory agencies.

These agencies recognize that many businesses lack sufficient technical resources for the in-house identification of waste reduction opportunities. While many of these agencies are willing to allocate resources to waste reduction technical assistance, businesses have demonstrated a reluctance to request such assistance from regulators . This reluctance has created a gap between the agencies who have the mandate and resources to provide the technical assistance and the companies who most need the assistance.

An Alabama Waste Reduction and Technology Transfer Program was begun in 1990 as a Tennessee Valley Authority concept and assisted by the Alabama Department of Environmental Management to fill that gap by offering technical assistance in a non-threatening way to Alabama businesses. This program was so successful, that it was incorporated in 1993 as the WRATT Foundation a non-profit 501(c)(3) Alabama corporation to enhance economic development and the quality of life in Alabama by providing resources to help business and industry reduce costs and waste through technical assistance, education, and research. Services provided by the Foundation are available to both the public and private sector. All technical assistance activities offered by the Foundation are conducted by teams of retired engineers and scientists.

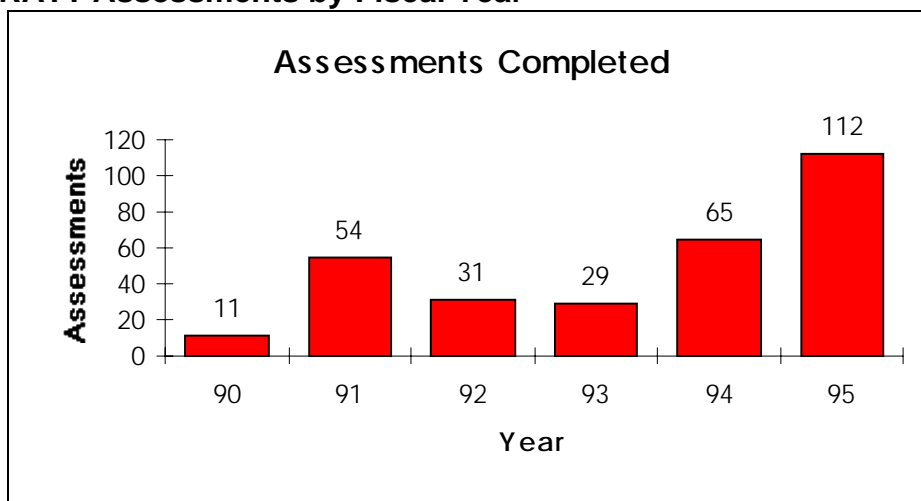
The public/private nature of WRATT's support has been a model of cooperation and efficiency in this era of reinventing government. From 1990 through 1994, \$695,794 was spent on this project. Of this only \$100,000 was provided by TVA. The balance was provided by private companies, other foundations, and EPA. The TVA support for this project was leveraged nearly 7 times.

In 1995, the Foundation began asking past clients to report on cost-effectiveness of implementing recommendations of the WRATT assessment teams. Of the first set of 50 companies, responses were received from 35. In the following pages the results they report are documented. Though only a fraction of the total number of recommendations were implemented, the total savings reported by these companies was almost 3.5 million dollars. In addition, the companies that did report acknowledged that other savings have been realized but cannot be quantified at this time.

## Summary

The success of the program is measured by the number of companies requesting the service, but more importantly by the actual number of assessments conducted. Since its inception in 1990, the number of assessments per year has increased dramatically through 1995. This annual (fiscal year basis) increase is shown in Figure 1.

**Figure 1: WRATT Assessments by Fiscal Year**



Another measure of the effectiveness of the WRATT Foundation program is the dollar amount of savings achieved by the reporting companies as the result of implementing WRATT Suggestions. The data presented in Table 1 represents total amounts of dollars saved and waste quantities eliminated from only 35 reporting companies not all of which reported savings and quantities. Most of these data represent annually recurring savings or reductions.

**Table 1: Summary of Savings and Reductions**

	Savings	Reductions
<b>Solid Waste</b>	\$2,648,432	36,419.90 tons/yr
<b>Hazardous Waste</b>	\$174,260	78.90 tons/yr
<b>Utility Savings</b>	\$444,400	
<b>Water Usage</b>	\$186,201	103,400 gallons/day
<b>Volatile Organic Compounds</b>	\$27,000	11.00 tons/yr
<b>TOTAL</b>	<b>3,480,293</b>	

Still another fact to be considered is the ratio of company dollar savings to dollars spent by WRATT on the assessments. This is covered in detail in sections "Study Results" and "Benefits to Cost Ratios" of this report. However, to summarize, saving the companies \$3.48 million with an expenditure of \$126,884 yields a benefit:cost ratio of about 27 to 1. That is, the program saves the companies about \$27 for every dollar WRATT spends in providing this service.

## Study Results

The data received from 35 responding companies referred to in the introduction are discussed in detail in the following Tables 2-6 in this section and Table 7 in section “Benefits/Cost Ratios” for WRATT assessments. Because of the diverse nature of companies and the individual nature of the information that was documented the data are not comparable in all cases. However, the overwhelmingly positive results from WRATT waste reduction opportunity assessments is clear.

Tables 2 through 6 document annual savings and waste reductions by the individual companies as supplied by the companies themselves. Because of the nature of the data, the amounts may not be related (see the individual case histories to identify the type waste reduced and the specific reason for savings). Companies not included in these tables reported that WRATT suggestions have saved them money and reduced waste, but the dollar amounts and tonnage have not been quantified.

**Table 2: Reported Reductions in Solid Waste**

WRATT# <sup>1</sup>	Savings	Reduction	Units
8/103	\$510,500	850.0	tons/yr scrap iron
12	\$49,500	5.5	tons @ 30 lb/drum (368 Scrap drums)
30	\$300		Reduced solid waste
45-51	NA	28,000.0	tons/yr Solid waste
67-68, #1	\$29,820	7.2	tons/yr solid waste
#2	\$28,000		Reduced raw material (solid waste)
69	\$28,500		Reduced solid waste
70	\$1,540,000	5,200.0	tons/yr solid waste
75	\$40,000	75.0	tons/yr solid waste
76	\$68,000	79.0	tons @ 7 lb/gal (22,500 gal/yr waste oil)
79-86	\$9,000		Reduced Solid Waste
88	\$8,100	108.0	tons/yr solid waste
91	\$16,525		Reduced solid waste
100	\$4,500	4.2	tons/yr solid waste
105	\$25,070	846.0	tons @ 25 lb/ft <sup>3</sup> (2507 yd <sup>3</sup> /yr solid waste)
106	\$42,000	1,200.0	tons/yr solid waste
107	\$2,000	25.0	tons/yr scrap iron
108	\$6,289		Reduced solid waste
109	\$9,020	20.0	tons/yr solid waste
112	\$250,000		Reduced solid waste
121	\$10,000		Reduced solid waste
143	\$5,508		Reduced solid waste
<b>Total</b>	<b>\$2,682,632</b>	<b>36,419.9</b>	

<sup>1</sup>Companies numbered 21, 25, 57, 113, and 148 provided no cost saving data, so were omitted. Companies numbered 26, 89, and 95 provided only partial data or ineffective results, so were omitted but were included in Table 7.



**Table 3: Reported Reductions in Hazardous Waste**

<b>WRATT #</b>	<b>Savings</b>	<b>Reductions</b>	<b>Units</b>
<b>20</b>	\$93,400	12.00	tons/yr hazardous waste
<b>41-42</b>	\$420.00	2.40	tons/yr hazardous waste
<b>45-51</b>		18.70	tons/yr hazardous waste
<b>67</b>	\$1,200	1.20	tons/yr hazardous waste
<b>69</b>	\$1,190		reduced hazardous waste
<b>75</b>	\$50,000	37.50	tons/yr hazardous waste
<b>91</b>	\$4,050		reduced hazardous waste
<b>121</b>	\$24,000	7.10	tons/yr hazardous waste
<b>Total</b>	\$174,260	78.90	

**Table 2: Reported Utility Savings**

<b>WRATT #</b>	<b>Savings</b>	<b>Reductions</b>	<b>Units</b>
<b>8/103</b>	\$40,000		Electrical usage
<b>32</b>	\$80,000	4,602	MCF Natural Gas & Utility
<b>67</b>	\$6,000		Utility cost
<b>79-86</b>	\$134,400		Reduced utility cost
<b>110</b>	\$84,000		Electrical usage
<b>133</b>	\$100,000		Electrical usage
<b>Total</b>	\$444,400		

**Table 5: Reported Reductions in Water Usage**

<b>WRATT #</b>	<b>Savings</b>	<b>Reductions</b>	<b>Units</b>
<b>41-42</b>	\$43,250	86,400	gallons/day water
<b>69</b>	\$4,042		reduced water consumption
<b>79-86</b>	\$63,400		reduced water consumption
<b>108</b>	\$50,789	17,000	gallons/day waste water
	\$16,320		reduced water useage
<b>143</b>	\$8,400		reduced waste water
<b>Total</b>	\$186,201		

**Table 6: Reported Reductions in Volatile Organic Emissions**

<b>WRATT #</b>	<b>Savings</b>	<b>Reductions</b>	<b>Units</b>
<b>67</b>	\$15,000	6	tons/yr
<b>68</b>	\$12,000	5	tons/yr
<b>Total</b>	\$27,000	11	tons/yr

## Benefit to Cost Ratios

The benefits of waste reduction opportunity assessments go far beyond savings. In fact, the purpose of the WRATT program is to help companies to see waste as a business competitiveness issue as well as an environmental issue. Data indicate that in many industry segments, the total cost of waste is more than the cost of labor; in some cases the differential is great. Helping companies to recognize this important fact and learn to identify and eliminate waste at every opportunity is an important economic factor in strengthening the competitiveness of our existing Alabama industries.

Also, an important evaluation tool is the ratio of company savings to the cost of assessments; i.e. the benefit:cost ratio. To evaluate the savings demonstrated by this study, it is necessary to determine the total and average costs of assessments during the time they were conducted. During 1990 through 1994, the WRATT Foundation spent \$695,794 to conduct 195 waste reduction opportunity assessments for an average of \$3,570 for each assessment. The actual cost of each individual assessment varied based on the size and complexity of the company. The Tennessee Valley Authority provided \$100,000 of the \$695,794 to support these assessments, which represents a leveraging rate of almost 7 to 1.

Therefore, the 50 assessments conducted at 35 ( 5 companies that could not quantify costs were excluded) companies cost WRATT a total of **\$126,844** and resulted in reported savings at assessed industries of **\$3,480,293**. The overall benefit to cost ratio for this work was **27** and the average savings per company assessed was about **\$102,000**. This is an amazing rate of return to have been based on so few of the total number of assessments that have been conducted.

**Table 7: Benefit/Cost ratios for WRATT Assessments**

<b>WRATT No.<sup>1</sup></b>	<b>Actual Assessment Cost</b>	<b>Reported Savings</b>	<b>Benefit/Cost Ratios</b>
<b>8/103</b>	\$8,079	\$550,500	68
<b>12</b>	\$4,194	\$49,500	12
<b>20</b>	\$2,347	\$93,400	40
<b>26<sup>2</sup></b>	\$1,508	\$0	0
<b>30</b>	\$1,769	\$300	0
<b>32</b>	\$1,754	\$80,000	46
<b>41-42</b>	\$3,889	\$43,670	11
<b>67-68</b>	\$1,009	\$57,820	57
<b>69</b>	\$3,557	\$33,732	9
<b>70</b>	\$7,721	\$1,540,000	199
<b>75</b>	\$10,761	\$90,000	8
<b>76</b>	\$2,518	\$68,000	27
<b>79-86</b>	\$7,151	\$206,800	29
<b>88</b>	\$7,606	\$8,100	1
<b>89<sup>2</sup></b>	\$7,785	\$0	0
<b>91</b>	\$2,615	\$20,575	8
<b>95<sup>2</sup></b>	\$3,062	\$0	0
<b>100</b>	\$2,481	\$4,500	2
<b>105</b>	\$11,938	\$25,070	2
<b>106</b>	\$4,008	\$42,000	10
<b>107</b>	\$6,894	\$2,000	0
<b>108</b>	\$2,604	\$73,398	28
<b>109</b>	\$1,181	\$9,020	8
<b>110</b>	\$1,955	\$84,000	43
<b>112</b>	\$7,449	\$250,000	34
<b>121</b>	\$3,062	\$34,000	11
<b>133</b>	\$5,103	\$100,000	20
<b>143</b>	\$2,846	\$13,908	5
<b>Total</b>	\$126,844	\$3,480,293	27

<sup>1</sup> Some companies numbered in the “Contents” were omitted from Tables 2-6 and Table 7 as indicated below.

- a) 21, 25, 57, 113, and 148 realized savings but could not quantify them.
- b) 45-51 quantified both waste amount (28,000 tons) but would not divulge dollar savings.

<sup>2</sup> Reported zero savings and/or lack of cost-effective savings.

**WRATT #8/103 Steel Joist Trusses**  
**SIC Code: 3441**

**Abstract:**

This company manufactures steel joists and girders used as main roof supports in wide span buildings, and interior floor supports in multi-level buildings. In 1990 their steel scrap was 2.25% of 82,000 tons. This figure is based on steel purchased versus steel shipped. The balance minus the inventory is scrap. No accurate weight of incoming steel and outgoing scrap existed for 1990. Paint sludge disposal and a \$100,000 per year charge back from customers who had to touch up incomplete or scraped paint on delivered products at the job site were the other concerns.

**Results:**

The WRATT Team made a total of 15 suggestions relative to waste streams throughout the plant. The following results have been reported:

- Implementing the suggested process and equipment changes reduced their steel scrap by 1% which amounts to 850 tons of steel annually, giving an annual savings of \$450,500.
- Capacitors were installed in their welding machines, which increased their energy efficiency and saved \$40,000 annually.
- Implementing suggestions relative to the painting process, the surplus welding wire on spools being scrapped, and the modification of wood dunnage saved an additional \$60,000 annually.

Total savings resulting from this waste assessment amounted to \$550,500 annually. The reduction in cost of waste disposal was not available.

**WRATT #12 Coffee Packaging**  
**SIC Code: 2095**

**Abstract:**

This plant manufactures lithographic tin plated steel sheets for metal cans, ends for metal cans and plastic screw on caps for metal jars packaging coffee. Processes involved include metal cutting and sizing, surface preparation, painting, lithographic printing, drying, application of a finish coat and final drying. In addition, four injection molding machines produce polypropylene plastic caps for glass jars.

**Results:**

The WRATT team made 8 suggestions for waste minimization in the areas of paper segregation, solvents recycle and energy. The plant reported that paper segregation and heat exchanger in the stack, to provide energy for plant heating and eliminate radiant heaters, were not "cost justifiable." Changes made relating to solvents resulted in a 90% conversion to bulk solvents which reduced the 512 - 55 gallon drums sent out in 1989 to 144 - 55 gallon drums in 1995, a savings of 386 drums/year @ \$26.00 drum, or \$9,500/year. The conversion to bulk solvents and varnish reflected in labor saving cost of \$40,000 annually for a total savings of \$49,500/year.

**WRATT #: 20 Garbage Truck Bodies**  
**SIC Code: 3713**

**Abstract:**

This company manufactures garbage truck bodies. The process involves the shearing, bending, forming and welding steel plates together to form the product which is cleaned and painted. The finished unit is attached to a customer supplied truck chassis.

**Results:**

The nine recommendations were supplied by WRATT. The company implemented suggestions on pre-treatment of steel and painting as follows:

- The procedures suggested changed the paint filters' classification from hazardous to non-hazardous. The savings involved 24,000 pounds per year of formerly hazardous filters that can now be landfilled (non-hazardous) resulting in a savings in disposal cost of \$48,000 annually.
- Additional procedural changes resulted in disposal cost savings of \$45,400.

Total savings of \$93,400 annually and a reduction of at least 24,000 pounds per year in hazardous waste occurred. Other observations made by WRATT are under consideration.

**WRATT #: 21 Sheet Metal Fabrication**  
**SIC Code: 3443**

**Abstract:**

This company repairs metal working machinery for resale. They are a job shop operation doing contract steel machining. They market and fabricate one product of their own design, a roof ventilator. Currently, scrap steel is sold to local scrap dealer, wastepaper and cardboard are collected and hauled to landfill, wood and broken pallets are hauled to the landfill, hydraulic oil and machine lubricants soaked up with Dririte and landfilled, fork lift motor oil maintenance is contracted to a local service station

**Results:**

The WRATT team's seven suggestions were investigated with the following results:

- Converting to natural gas as opposed to acetylene gas, may be considered as part of planned upgrade.
- Scales to weigh incoming steel, recycling gloves, and suggested production changes to ventilator rim and clip production were judged to be impractical by the company.
- Some savings in reducing waste, water and energy costs, as well as, material recovery cost were reported but no figures are available.

The WRATT group's impact cannot always be measured in terms of "dollars saved." In this case, it channeled the company's thinking into at least an investigation of the suggestions.

**WRATT #: 25 Ceramic Tile**  
**SIC Code: 3253**

**Abstract:**

This company manufactures glazed ceramic tile for use in residential, commercial and industrial applications. Tile is made from clays and minerals blended and formed mechanically into 4" x 4" squares ¼" thick. The tile is then sprayed with glaze slip and fired in a tunnel kiln at 2000° F. The process involves raw material handling from bulk containers as well as palletized bags.

**Results:**

The WRATT team made a total of eight suggestions. The returned questionnaire included no information on implementation. The company does not have a waste reduction program in place.

**WRATT #: 26 Ductile Iron Pipe**  
**SIC Code: 3321**

**Abstract:**

This plant produces 4- to 12-inch diameter ductile iron pipe for water lines. The WRATT assessment team noted that this company was doing an excellent job of managing most of their wastes. The team offered six suggestions relating to waste heat recovery and reduction of energy requirements.

**Results:**

The installation of a metallic recuperator to provide preheated combustion air to the annealing oven burners was not considered to be cost-effective by the company. Automatic air/gas ratio burners were installed in the rapid heating zone of the annealing ovens. It is too early to document savings.

Suggestions were made relative to ladle burner replacement. But, due to environmental regulations, ladle burners were replaced with low NOx burners which are inherently less efficient.

All welding flux is now being recycled at another plant. No savings recorded as yet, but they exist. WRATT suggested the wiping rags be recycled as opposed to burning. The company tried this approach but found no cost benefit from this service and felt that there would be logistical problems.

Combining the ductile treatment baghouse collector with the cupola baghouse system was evaluated. Due to the temperature difference in the two streams (100° versus 550° F), it is not practical to combine them.

**WRATT # 30: Children's Socks**  
**SIC Code: 2252**

**Abstract:**

This company produces knitted socks from cotton and nylon yarn. Lint generated from the knitting operation was well controlled by an efficient vacuum system. Production areas were clean and well ventilated. Reject socks are sold for recycling. Lint, office waste paper, and miscellaneous refuse are sent to the landfill. Cardboard is collected for recycling. Generated waste heat from a "boarding operation" is utilized for heating in cold weather. A Safety Kleen system is used in the plant for machine parts clean-up. Disposal costs are \$135.00 per month. A dye house will be relocated from another location to improve production flow.

**Results:**

The company has implemented the following suggestions.

- Glass drink bottles were eliminated in favor of aluminum drink cans.
- Recycling revenue increased to \$300/year due to recycling.
- They changed over to plastic returnable 55-gallon drums.
- Office paper, yarn cones, and cardboard are being recycled as suggested by WRATT. This is not profitable but keeps the material out of the landfill.
- A heat exchanger will be installed in the new dye house.

**WRATT # 32: Rigid Narrow Fabrics**  
**SIC Code: 2241**

**Abstract:**

This company produces narrow fabrics, specifically belting, webbing, and strapping using both natural and synthetic fibers. Cardboard is recycled. Loom oil is recycled and used in other lubrication applications. Aluminum cans are recycled. The company uses a computer program which tracks hazardous chemicals and replaces them with non-hazardous substitutes where possible. The WRATT team provided six recommendations relating to spinning, winding and weaving, and dyeing and finishing.

**Results:**

The WRATT team visit and the subsequent waste minimization report resulted in a process and procedure change. The company installed a new continuous dyeing operation. In only six months after operation, the savings became noticeable. These savings are continuous and the new process providing more efficient use of gas ovens as steam cans has reduced gas consumption by 4,602 MCF with a cost savings of \$40,900 annually. Their total utility cost reduction was \$80,000 annually.

**WRATT # 41 & 42 Screening and Industrial Fabrics**  
**SIC Code: 3496 & 2262**

**Abstract:**

This plant produces aluminum wire screen, fiberglass screen, polyester fabric screening and drawn aluminum custom products. Six recommendations were provided concerning the metal working area, the fiber product area and the weaving area.

**Results:**

The WRATT team's suggestions relating to excess water consumption and the reduction of hazardous sludge resulted in the following savings:

- Installing a cooling tower to recycle lubricant cooling water was estimated to save \$70.00/day, but it saved much more. They reduced their water consumption and waste water by 86,400 gallons/day which equates into \$173.00/day or \$43,250 based on 250 working days.
- Through equipment and process changes the hazardous waste sludge was reduced by 4,800 pounds at a savings of \$420.00/year.

Implementation of the WRATT suggestions resulted in savings of \$43,670 annually.

**WRATT # 45 through 51: Paper Manufacturing**  
**SIC Code: 2621**

**Abstract:**

This primary paper mill produces 900 tons per day of high quality paper for the printing industry along with 125 different tissue-products in several colors. Their most pressing problems at the time of the assessment were the cost of solid waste disposal and the hydraulic load on the wastewater treatment system. The goal of the company is to increase production rates without increasing waste stream volumes.

**Results:**

The company reported the following achievements based on WRATT recommendations:

- Solid waste was reduced by 56,000,000 pounds/year. The company's policy relative to confidential business information does not allow release of information on dollar savings.
- Hazardous waste suggestions resulted in a saving of 37,300 pound/year. No dollar savings information is available.

The company stated that "the WRATT group, with their diversified array of talent should continue helping industry accomplish waste reduction goals."



**WRATT #57: Dipped Rubber Products**  
**SIC Code: 3061**

**Abstract:**

This manufacturing facility produces thin-wall latex products, medical examination gloves and prophylactics. Currently, cardboard is collected and recycled to a local vendor, aluminum cans are collected for recycling, empty 55-gallon drums are sold, rags used for clean-up are washed and recycled, and office paper is shredded and landfilled (no paper is recycled due to confidentiality). Ammonia released by the process amounts to 11 to 499 pounds per year. Although an odor lingers, the concentration is within limits.

**Results:**

The company indicated that their boiler oven was converted from coal to oil/natural gas. Savings from the conversion is not yet known. They tried to identify a scrap latex buyer, but concluded that the market would not provide for a satisfactory long-term solution. Savings due to equipment change and improved housekeeping have not been quantified.

**WRATT # 67 & 68: Wood Dining Room Furniture**  
**SIC Code:2511**

**Abstract:**

This plant manufactures wooden dinette furniture in two plants. The assembled items are painted or stained and varnished. Wood waste is burned in a co-generation steam boiler to generate electricity in the summer and steam for heating in the winter. Waste paint containing solvents which cannot be recycled is landfilled. Paper filters from the paint spray booth are landfilled. Pallets are given to employees and nearby businesses. Cooling water is retained in a pond and recycled for the co-generation operation. Miscellaneous trash is landfilled. The company's goal is to reduce their solvent waste and VOC emissions to a level not requiring air pollution permits.

**Results:**

The company's management team used the WRATT report to establish a priority listing of changes to be made. Process and equipment changes reduced VOC emissions by 12,000 pounds per year, savings of \$15,000 per year. Suggested material changes resulted in hazardous waste reduction of 2,400 pounds per year with an annual saving of \$1,200. Disposal costs were reduced by \$4320 annually. Raw material costs were reduced by \$3,300 per year. Utility cost has been reduced by \$6,000 per year. Total savings at Plant #1 was \$29,820.

At Plant # 2 (WRATT #68), air emissions were reduced by 10,000 pounds with an annual cost savings of \$12,000. The raw material change reduced cost by \$16,000 annually. Total cost savings realized was \$28,000.

**WRATT # 69: Fire Hydrant Manufacturer**  
**SIC Code: 3321**

**Abstract:**

This is a large grey iron foundry and machine shop. WRATT suggestions concerned extending the life of the coolant used in the machining operation, reducing the cost and waste from parts washing and other water use, reducing solvent cost in sludge disposal.

**Results:**

Suggestions offered in the WRATT report were implemented with the following results:

- Savings from reduced hazardous waste were \$1,190 in the first year.
- Savings from reduced water consumption were \$4,042 in the first year.
- Disposal cost savings amounted to \$27,000 per year.
- Labor costs were reduced by \$1,500 per year.

The total cost savings amounted to \$33,732 annually. The company did not report weight or cubic yards of waste reduced.

**WRATT # 70: Polyester Fabric**  
**SIC Code: 2221**

**Abstract:**

This company manufactures athletic apparel, uniforms, etc. WRATT's recommendations covered wastewater, cotton sweepings (now being burned in the boiler), scrap wood, scrap cloth remnants, and packing waste.

A new recycle center collects recyclables and sells or trades low volume liquid waste. Landfill volume has been reduced from 300,000 pounds per week in 1989 to 113,000 pounds per week three years later (1992). Their goal is to reduce solid waste to zero. This company has a strong waste minimization program. WRATT offered suggestions for further improvement.

**Results:**

Implementation of WRATT recommendations has had impressive results. The disposal of solid waste was reduced by 5,200 tons per year at an annual cost saving of \$260,000. Disposal costs were lowered by \$780,000 annually. Recyclable material recovery cost was lowered by \$500,000. Intense recycling programs have increased labor cost but it is without doubt cost-effective.

The WRATT suggestions relative to the conversion of fiber and fabric waste into useful raw material, is under careful consideration. Experiments with cut waste is underway producing fibers and making shirts of these reclaimed fibers.

**WRATT # 75: Steel Mill**  
**SIC Code: 3312**

**Abstract:**

This plant produces steel plate, hot rolled, cold rolled, galvanized steel strip and sheet steel. The annual production is 1,250 million tons of steel. A major concern expressed to the WRATT team was the life of their on-site landfill which is estimated to be no more than five years.

A major energy reduction program instituted in 1989 was most successful and resulted in cost savings of \$1,500,000 per year. This program has diminished recently and so have the savings. For example, estimated savings in the plate mill have dropped from \$500,000 to \$9,000 annually. Steam losses have risen to 15% from 5%.

**Results:**

Implementing WRATT recommendations resulted in significant cost savings.

- As a result of process changes, hazardous waste was reduced by 75,000 pounds annually at a cost savings of \$50,000 annually.
- Changes in solid waste segregation procedures resulted in a solid waste reduction of 150,000 pounds with an annual cost savings of \$40,000.

Total annual savings were 225,000 pounds of solid and hazardous waste. The resulting cost saving was \$90,000 annually.

**WRATT # 76: Tapered Roller Bearings**  
**SIC Code: 3562**

**Abstract:**

This plant produces large steel tapered roller bearings for trucks and tractors. The company formed a team of 25 people and started a waste minimization program in January, 1992, with 34 objectives each of which could save \$1,000 to \$10,000 or more annually.

The WRATT team provided suggestions concerning recovery of waste heat, evaluation of the company's power factor, reducing compressed air leakage, segregating wastes for more effective recycling and disposal, repairing water leaks, and investigating a synthetic coolant on at least part of the process equipment.

**Results:**

WRATT waste reduction survey suggestions were implemented over a 15-month period with the following results:

- As suggested; the company installed a gravity separator to reclaim quenched oil from washers, leaks, and spills in the heat treatment area. As a result, oil waste was reduced by 22,500 gallons per year, at a savings of \$68,000 annually.

**WRATT # 79 - 86: Research Center**  
**SIC Code: 49**

**Abstract:**

This is a research and development center. The main product is improved technology which is transferred worldwide. The WRATT team was asked to investigate opportunities relative to wastewater, solid waste, and energy conservation associated with heating. The WRATT team made suggestions in these areas.

**Results:**

The suggestions made by the WRATT team were implemented in the environmental research building and the service building, which resulted in process changes and preventative maintenance and equipment changes. Annual savings of \$9,000 were reported concerning solid waste costs. Also, water consumption was reduced saving \$63,400. The annual energy cost savings totaled \$134,400. In addition, labor costs were reduced but dollar amounts were not available.

**WRATT # 88: Magnetic Recording Tape**  
**SIC Code: 3679**

**Abstract:**

This company manufactures professional audio, video, and instrumental recording tape. The WRATT team was invited to look for cost and waste reductions beyond what the company's own efforts have identified.. The WRATT team offered suggestions concerning scrap disposal, waste segregation, and recycling choosing vendors that support the company's waste reduction goal, reducing water use, improving water treatment, reducing solvent use, and reducing energy use

**Results:**

The company elected to start recycling cardboard and white paper immediately. The results were evident. By recycling they kept 108 tons of cardboard from the landfill and saved \$8,100 annually.

**WRATT # 89: Agricultural Chemicals**  
**SIC Code: 2879**

**Abstract:**

This company manufactures pesticides and herbicides. These chemicals are sold to formulators who process them into the final product. Each process area is staffed by personnel well schooled in waste minimization. Since their processes are proprietary and generally complex, the WRATT team's attention was devoted primarily to end waste streams from each process unit. Suggestions were offered related to steam conservation, use of fine coke, heat transfer oil alternatives, energy conservation, and recycling.

**Results:**

Since the assessment, the company's waste streams have increased due to the shut-down of their deep wells. This problem has been addressed using biological treatment of all waste streams. An in-house biological treatment manufacturing technology group is working on waste stream reduction. No waste reduction or cost savings were provided. The company indicated that the WRATT report was accurate, but they have not been able to use the suggestions made.

**WRATT # 91: Hydraulic Cylinders**  
**SIC Code: 3593**

**Abstract:**

This plant manufactures hydraulic and pneumatic cylinders in a machine shop. A waste management program is in place and reductions in disposal cost have been noted over the years. The WRATT assessment team identified new opportunities for waste reduction and cost savings. Recommendations concerned reducing coolant waste, improving hydraulic test oil life, disposal of pallets and scrap wood, solvent cleaning alternatives, scrap metal management, alternate painting systems, and recycling alternatives.

**Results:**

More than 50% of the WRATT team's suggestions were implemented and an additional 25% are under evaluation. Those suggestions implemented resulted in an annual savings of \$4,050 in hazardous waste reduction and \$2,275 in solid waste reduction. Because much of this material was reclaimed, an additional \$8,250 was saved on disposal cost and \$6,000 was saved on raw material. The total annual savings directly attributed to the WRATT suggestions, which also involved the recycling of coolant and oil, amounted to \$20,575.

**WRATT # 95: Portland Cement**  
**SIC Code: 3241**

**Abstract:**

This plant produces over 500,000 tons of Portland cement per year. The company is reducing the primary kiln fuel (coal) feed rate by using waste derived fuel, i.e. scrap tires fed whole to the kiln preheater base. The only waste stream discussed during the visit was the spent heavy-mill/kiln drive lubricant that is shipped to another of their plants. This material should be considered for use as a waste derived fuel.

**Results:**

The use of scrap tires in cement kilns is very useful; however, to use them as a sole source of fuel is not possible in a kiln that has no alkali bypass. The company indicated that “the service WRATT provides is valuable, however in our case it is important to understand our manufacturing process.”

**WRATT # 100: Gauze Material**  
**SIC Code: 2211**

**Abstract:**

This company produces substrates for medical and industrial tape, and medical gauze and wrap. Waste fiber is returned to the process prior to blending. Thread waste is collected, baled, and sold. Loose fiber, floor sweepings, lint, etc., collected through the vacuum system, are also baled and sold. Surplus pallets are given to a brick yard, plastic crates are returned to the vendor, and waste oil and drums are picked up by a recycler.

WRATT’s recommendations concerned energy conservation, starch recovery, water conservation, and waste segregation and recycling.

**Results:**

The WRATT team’s suggestion to recover the starch solution resulted in reduced sanitary sewer discharges and in reducing solid waste generation by 8,333 pounds annually and disposal cost by \$1,000 per year. Recovered raw material was worth \$3,500 per year.

### **WRATT # 105: Paper Board**

**SIC Code: 2631**

#### **Abstract:**

This plant produces 1,150 tons per day of corrugated material which is shipped to other locations and used in making corrugated board containers. The company's goal is to eliminate wastes going to the landfill, reduce fiber loss and process water usage rate, and completely remove plastics from the wastewater effluent treatment. The WRATT team offered suggestions concerning preventive maintenance, preventing plastics from reaching the wastewater, recovering spilled material, and wastewater treatment.

#### **Results:**

The team suggested a piece of equipment which would remove plastic from the wastewater. This equipment in conjunction with a suggested process change reduced the solid waste to landfill by 2,507 cubic yards annually at a cost saving of \$25,070.

### **WRATT # 106: Ferrosilicon**

**SIC Code: 3313**

#### **Abstract:**

Waste reduction recommendations from WRATT concerned cooling tower water, marketing slag, improving the operation, and life of the wastewater ponds.

Evaluate the sealed cover on the electric furnace to determine the potential for saving electrical energy by improving the seal and the impact on waste heat recovery.

#### **Results:**

WRATT suggested solid waste reduction through equipment changes such as installation of storage bins. This simple change resulted in the reduction of 1,200 tons per year of solid waste with a savings of \$42,000 per year in disposal costs.

## **WRATT # 107: Insulation Material**

**SIC Code: 2679**

### **Abstract:**

This plant produces mineral fiber from basalt rock. The bulk of the fiber is used for insulating boards and blankets, pipe insulation, and blow-in insulation. High volumes of waste are generated. In 1992, total waste cost exceeded \$3,000,000 of which \$560,000 was for waste disposal. The WRATT team identified waste reduction opportunities concerning waste segregation and cleanup efficiency, recovery of iron slag, reclaiming rock wool melt, disposition of coke breeze and baghouse dust, treatment of cooling water, and handling of recyclables.

### **Results:**

WRATT's suggestion sell the iron drained from the cupola was the only one accepted. Selling this scrap iron resulted in an annual savings of 50,000 pounds and a cost reduction of \$1,000 per year. In addition, they saved another \$1,000 in disposal costs. Total savings are \$2,000 per year.

## **WRATT # 108: Wire Cages (poultry)**

**SIC Code: 3496**

### **Abstract:**

This company manufactures wire cage systems for use in the chicken houses. The team made suggestions regarding increasing the life of the annealing and galvanizing line baths, handling and sale of recyclables, and tracking raw material receipts by weight.

### **Results:**

Suggestions from the WRATT assessment team combined with further evaluations resulted in the following savings:

- Reduced wastewater by 17,000 gallons per day by reducing the size of the spray nozzles by one third and increasing drainage time.
- Original water cost including treatment and disposal was \$103,896 per year. Cost of water, after implementation of WRATT's suggestions, is \$53,107 per year.
- Savings of \$50,789 and water reduction of 17,000 gallons per year.
- Additional savings resulted in:

1. Disposal cost	= \$ 5,636
2. Raw material	= \$ 653
3. Water treatment	= <u>\$16,320</u>
Subtotal	= \$22,609



- Total Annual Savings: \$73,398

**WRATT # 109: Electric Plating**  
**SIC Code: 3471**

**Abstract:**

This company specializes in electroplating and zinc coating. Most of the material plated is threaded steel rods used in the construction industry as pipe hangers. The WRATT team made suggestions concerning conserving and extending the life of bath fluids, improving the wastewater treatment system, recovery of metal bearing sludge, and waste heat recovery.

**Results:**

Many of the suggestions concerning wastewater and sludge recovery had been tried, but the company is willing to try again. Suggestions relating to more efficient neutralization of the rinse water line and other suggestions involving storage yard recyclable materials have been implemented. The results have been a reduction in solid waste of 40,000 pounds at a cost savings of \$760, a reduction in disposal costs of \$1,060, and a reduction in raw material costs of \$3,200. Also, by issuing only one pair of rubber coated gloves per week to the employees, as opposed to the four pair per week they were using, the company saved \$4,000 annually. Total annual savings were \$9,020 and 40,000 pounds of waste.

**WRATT # 110: Steel Tubular Products**  
**SIC Code:3317**

**Abstract:**

This company manufactures a variety of tubular products including basic formed tubing. The WRATT team noted several possibilities for reducing the volume of contaminated mill coolant lubricant and the associated disposal cost as well as recommendations on energy conservation.

**Results:**

The WRATT team made ten suggestions which could save time, energy, and raw materials. Three of the suggestions were implemented fully with others pending. Of the three, results for only one was reported; the installation of capacitors on large motors reduced energy cost by \$84,000 per year.

**WRATT # 112: Agricultural Chemicals**  
**SIC Code: 2879**

**Abstract:**

This plant is above average among fertilizer plants for minimization of process waste. However, the plant is located in an area with restricted air and water discharges with additional restrictions being considered. WRATT made suggestions intended to conserve process material and energy and to reduce the company's potential environmental liability.

**Results:**

The WRATT team made suggestions resulting in a reduction in wastewater to the cooling tower. The WRATT group only suggests and does not implement recommendations. It suggested a firm who developed and implemented the changes. The result was a material recovery savings (recyclable materials) of \$250,000. Other suggestions made in the waste assessment were known to the company but it was helpful to them to validate their own thinking from a different perspective.

**WRATT # 113: Agricultural Chemicals**  
**SIC Code: 2879**

**Abstract:**

This plant produces explosive grade ammonium nitrate prills and fertilizer grade ammonium nitrate granules from liquid anhydrous ammonium and nitric acid produced on-site. WRATT suggestions concerned improving containment around storage, improving preventive maintenance, energy conservation, runoff control, and general recycling.

**Results:**

The company's response to the WRATT team's visit was encouraging. Although no pounds or dollar savings were quantifiable, the following quote indicates the type of assessment result that keeps paying dividends long after the assessment. "Most of the reduction was in source elimination due to better training, understanding procedures, and operation attentiveness."

**WRATT # 121: Aircraft Parts**  
**SIC Code: 3728**

**Abstract:**

This plant is an assembly shop for the aircraft and rocket industry. Parts to be assembled are light weight material such as aluminum and graphite sheet and titanium rivets. Many of these parts require painting. The WRATT assessment team provided recommendations concerning energy conservation, preventive maintenance, recycling of shop rags, disposition of wastewater, painting efficiency, hazardous waste disposal, off-spec paint disposition, and general recycling.

**Results:**

Budget constraints would not allow implementation of all suggestions. Some of the suggestions were implemented reducing hazardous waste by 14,200 pounds with a saving of disposal costs totaling \$24,000 annually. In addition, recycling shop rags saved \$10,000 annually for a total annual savings of \$34,000.

**WRATT # 133: Micro Silica**  
**SIC Code: 3339**

**Abstract:**

The principal product produced at this location is high-grade silicon used to produce silicon chips. A second grade is produced for alloying aluminum ingots. A by-product of this operation is micro silica which is sold to refractory producers. WRATT suggestions concerned material handling efficiency, disposition of wood bark from one of the company's contractors, and energy conservation.

**Results:**

The company reported that installing capacitors on nine 125 HP recirculating pump motors increased the power factor from 70% to 94%; saving an estimated 304 KWH and resulting in a \$100,000 annual savings.

**WRATT #143: Polystyrene Packing**  
**SIC Code: 3089**

**Abstract:**

This plant produces a diversified product line of expanded foam packaging shapes and coolers. WRATT's suggestions concerned energy and steam conservation, wastewater handling, cooling efficiency, and general recycling,.

**Results:**

WRATT suggestions relative to segregation recyclables and wastewater controls resulted in a reduction in solid waste, saving \$5,508 per year. The installation of a wastewater meter resulted in savings of \$8,400 per year. Gallons saved was not available. Total savings were \$13,908 annually.

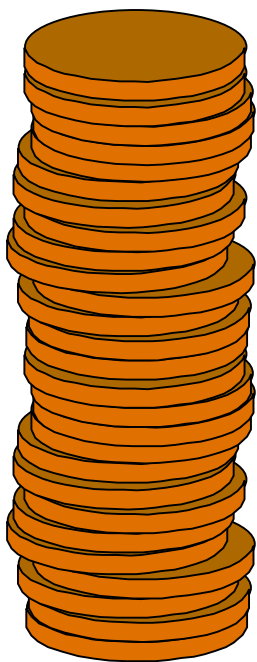
**WRATT # 144: Clay Refractories**  
**SIC Code: 3255**

**Abstract:**

This company fabricates refractory products. The WRATT team identified waste reduction opportunities relating to kerosene contaminated waste generated in the mud room, recycling of plastic wrapping film, packing waste reduction, recycling of steel drums, energy conservation, and office waste recycling.

**Results:**

The WRATT team provided this company with seven cost saving and waste reduction suggestions. The company stated that the report was very helpful, but more time is needed to contact suppliers before implementing the suggestions. No savings figures are available.



## **Benefit to Cost Ratio 27:1**

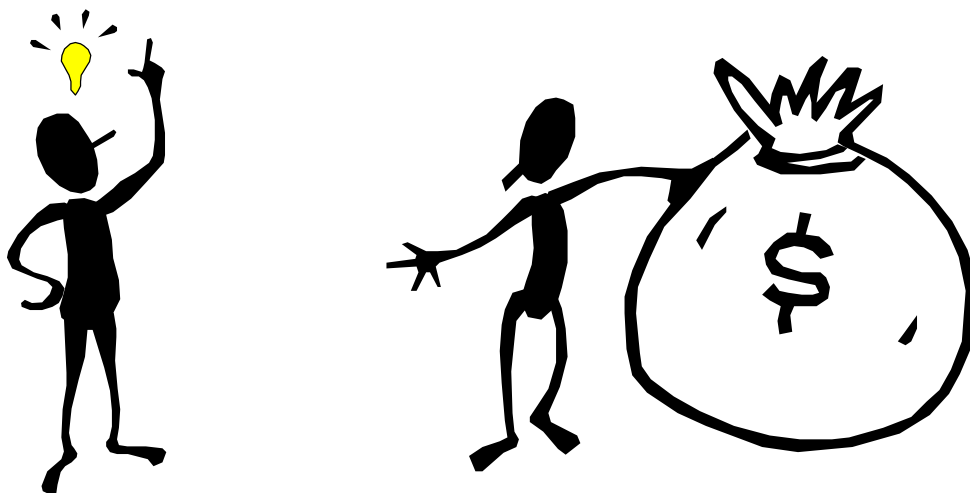
WRATT Waste Reduction Opportunity Assessments save companies an average of \$27 for each dollar spent.



**Figure 2**

---

## **WRATT Ideas Save Money**



Companies save an average of about \$100,000 based on WRATT recommendations.

**Figure 3**

---